Sept. 24, 1940. F. J. HEIDEMAN 2,215,700

PUMP

Filed Sept. 2, 1937 2 Sheets-Sheet 1

Fig. 1

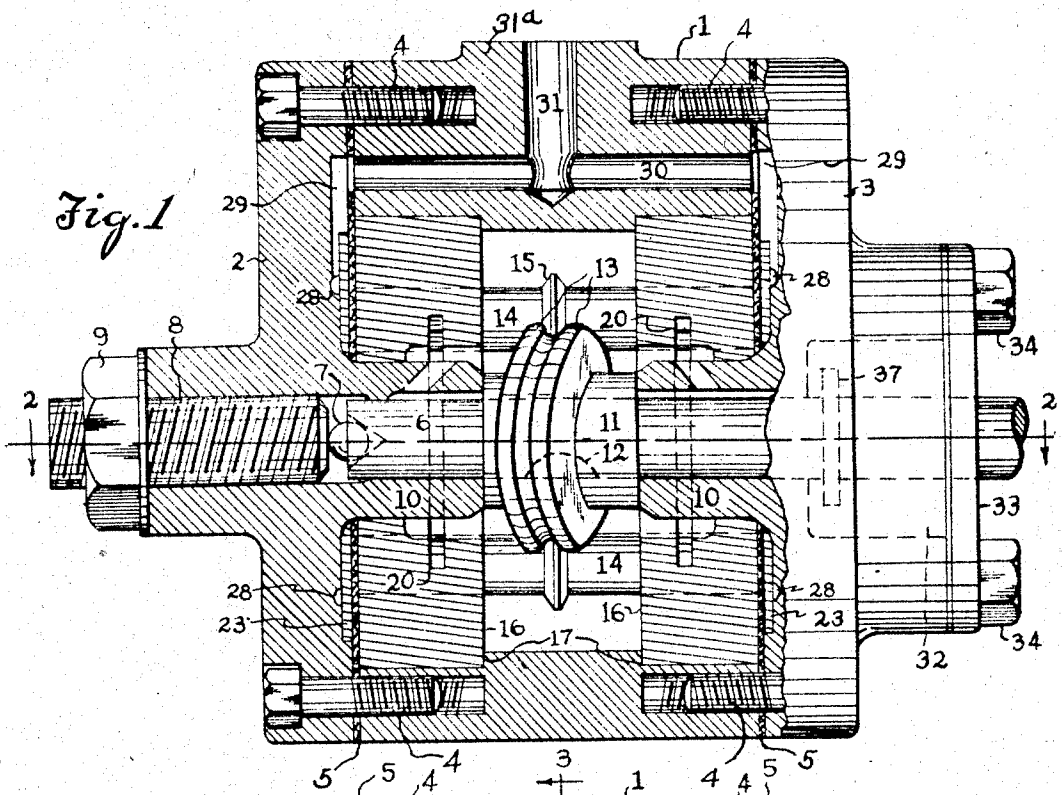
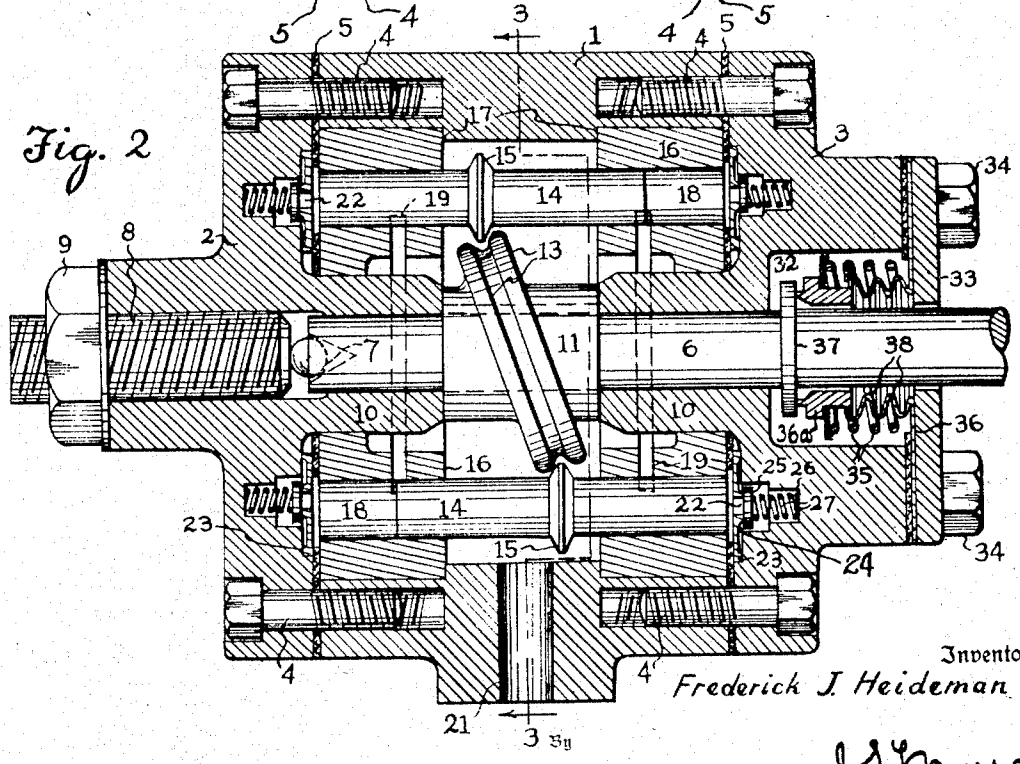


Fig. 2



Inventor

Frederick J. Heideman

J. S. Murray

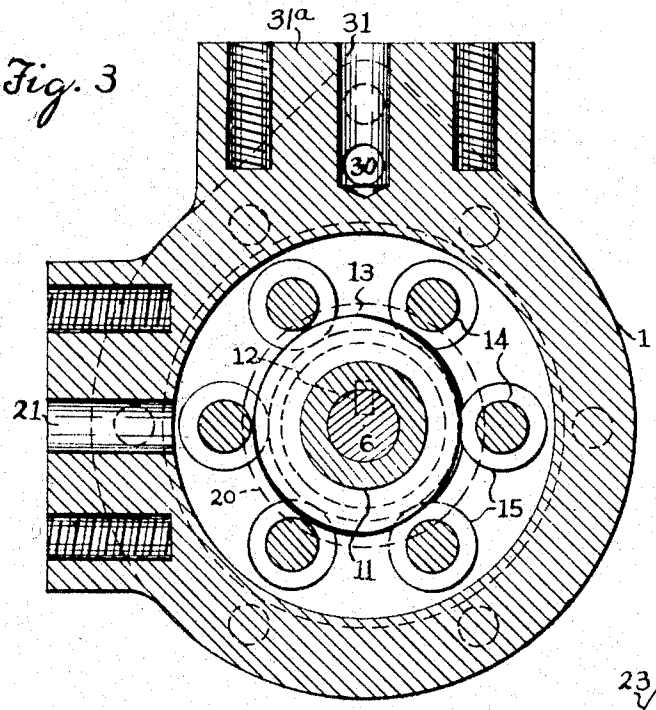
Attorney

Sept. 24, 1940. F. J. HEIDEMAN 2,215,700

PUMP

Filed Sept. 2, 1937 2 Sheets-Sheet 2

Fig. 3



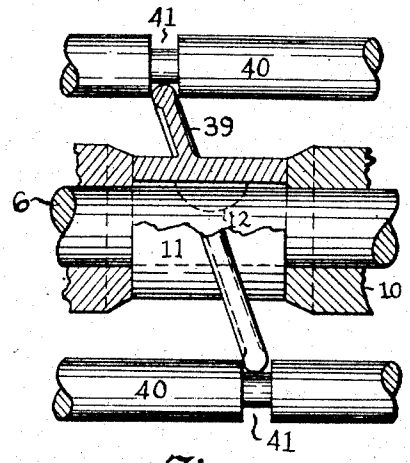
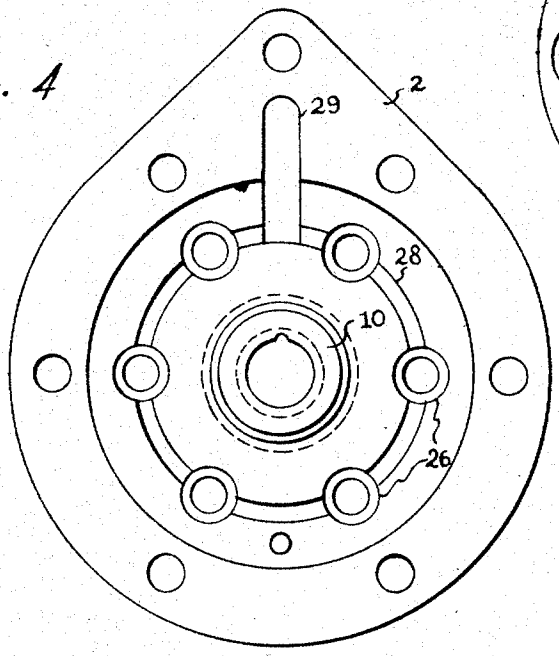


Fig. 6

Fig. 4



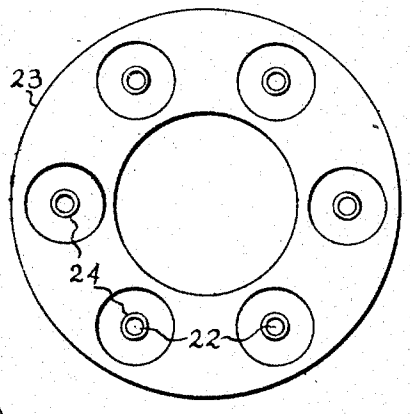


Fig. 5

Inventor

Frederick J. Heideman

By

J. S. Murray

Attorney

Patented Sept. 24, 1940 2,215,700

UNITED STATES PATENT OFFICE

2,215,700

PUMP

Frederick J. Heideman, Detroit, Mich.

Application September 2, 1937, Serial No. 162,169

2 Claims. (Cl. 103—173)

This invention relates to pumps, either for liquid delivery or for compression of air or other gases.

An object of the invention is to provide an improved drive for a double-acting, multi-cylinder pump, permitting a desired pumping or compressing capacity to be derived from a considerably smaller and lighter pump than has heretofore been feasible.

Another object is to provide a drive mechanism adapting any desired number of double-acting pistons to be reciprocated in common by a rotary drive element, having a swash plate action.

A further object is to adapt the inlet ports of a circular series of pump cylinders to be formed simultaneously by a simple and rapid machine operation.

A further object is to provide an improved valve arrangement to control the cylinder outlet ports of a double-acting, multi-cylinder pump.

These and various other objects are attained by the construction hereinafter described, and illustrated in the accompanying drawings, wherein:

Fig. 1 is a vertical axial sectional view of the improved pump.

Fig. 2 is an axial horizontal sectional view thereof.

Fig. 3 is a cross section taken upon the line 3—3 of Fig. 2.

Fig. 4 is a view of the inner face of one of the end heads of the pump casing.

Fig. 5 is a view in elevation of one of two annular plates formed with discharge ports for the pump cylinders.

Fig. 6 is a fragmentary elevational view, partially in section, showing a modification of the drive connection from the shaft to the pistons.

In these views, the reference character 1 designates the substantially annular, center member of the pump casing, and 2 and 3 a pair of heads closing the ends of said member, and secured to the latter by bolts 4, the joints being sealed by gaskets 5. A shaft 6 journaled in said heads, axially of the casing, projects, at one end, beyond the head 3, for engagement by any suitable rotary drive means, (not shown) the other end of such shaft being centrally recessed to seat a ball 7, establishing a thrust bearing against an adjusting screw 8 centrally carried by the head 2. A locknut 9 on such screw seats exteriorly against the head 2 to maintain any desired adjustment. Within the casing, the shaft 6 carries a driving element, fitted snugly between hubs 10 which project toward each other from the heads 2 and 3. Said driving element comprises a collar 11, fixed on the shaft by a key 12, or equivalent means, and a swash plate arrangement formed by two similar, spaced, coaxial annular ribs 13, the axis of which intersects that of the shaft at a divergency to the latter, approximating sixty degrees. Driven by the element 11, 13, is a set of double-acting pistons 14, reciprocatory in parallelism with the shaft 6 and equidistant therefrom, and distributed around the shaft in an equiangular spaced relation. Each piston is formed, midway of its length, with an annular rib 15, substantially conical in its axial cross section, and all of such ribs 15 engage between the swash plate ribs 13, adapting the latter to jointly reciprocate the pistons. End portions of the pistons are slidingly fitted in two annular cylinder blocks 16, set snugly into the end portions of the casing member 1 in a surrounding relation to the hubs, and clamped by the heads 2 and 3 against a pair of spaced annular shoulders 17, interiorly formed on said member. Said blocks are formed with bores 18 accommodating the pistons, and fluid inlet ports 19 open from such bores toward the shaft 6. Said ports of each cylinder block are formed preferably by machining such block with an annular groove 20, extending from the inner peripheral face of the block and cut to a depth to establish the desired area of intersection with the cylinder bores. Thus the intake ports of each block may be accurately and simultaneously formed by a rapid and simple machine operation. The ports 19 are in open communication with a central space within the pump casing, and the member 1 is formed with an admission opening 21 for the fluid to be pumped or compressed.

The exhaust ports 22 of each cylinder block are formed preferably in an annular plate 23, so clamped between the heads 2 and 3 and the member 1 as to locate such ports at the cylinder axes. Said plates have their outer faces formed with raised annular lips 24, marginal to the ports 22, forming seats for disk valves 25. The heads 2 and 3 have sockets 26, individually accommodating such valves, and further accommodating coiled springs 27, yieldably seating the valves.

The sockets 26 of each head are interconnected by an annular groove 28, formed in the inner face of the head to carry off fluid discharging from the cylinders, said heads each further having a radial groove 29 outwardly extending from the groove 28, and serving to deliver the discharging fluid to opposite ends of a bore 30, ex-

tending through the member 1, in parallelism with the shaft, and intersected at its mid portion by an outlet passage 31, extending to the outer face of the member 1. Preferably the casing has an exterior enlargement 31*a* to accommodate the passages 29, 30 and 31.

Any suitable provision is made for preventing leakage of fluid along the shaft 6, as it extends through the head 3. As illustrated, said head is formed, in its outer portion, with a chamber 32 surrounding the shaft and closed by a plate 33 secured to the head by bolts 34, and apertured to accommodate the shaft. A spring 35 is compressed within the chamber 32 between a gasket 36, interiorly engaging the plate 33, and a ring 36*a*, surrounding the shaft and maintained by said spring in fluid-sealing engagement with an annular flange 37 on the shaft. The sealing ring 36*a* and gasket 36 are further connected by a corrugated flexible sleeve 38 establishing a fluid seal.

In some installations and particularly the larger ones, it may be preferable to employ a driving element, as shown in Fig. 6, having a single annular rib 39, of a swash plate type, the pistons 40 of the pump being annularly grooved midway of their length, as indicated at 41, to accommodate such rib, this being a reversal of the first described construction.

In operation of the described pump, when the shaft 6 is rotatively driven, the swash plate ribs 13 act upon the ribs 15 of the pistons to reciprocate the latter, each stroke of each piston producing simultaneously a compression in one of the two cylinder blocks and a suction in the other. As each piston completes a stroke, its trailing end uncovers the port 19 of the corresponding bore 18, permitting a rush of fluid into the bore. On the following stroke the fluid is discharged through the port 22 of said bore, being first compressed, in case the fluid is a gas. The spring 27 corresponding to said bore yields under pressure of the fluid to permit unseating of the valve 25 and escape of the fluid.

The described type of cylinder block permits a considerable number of cylinders to be very compactly grouped, and makes possible accurate machining of all the intake ports in a single operation. The use of a considerable number of cylinders is desirable from the standpoint of efficiency and smooth operation.

Because of its compact size, high relative capacity and lightness, the described pump is suited to many installations where ordinary pumps of equal capacity would not be practicable. Among the numerous purposes for which this pump is especially suited may be mentioned aircraft and submarine and other marine installations, Diesel engine fuel delivery, the metered delivery of liquids, and the delivery of oil to machine tools.

It is to be noted that the driving member 11, 13 will impose a quite gradual rotation, as well as reciprocation, on the pistons 14, thus insuring equal wear of the peripheral face of the pistons, and also distributing wear on the ribs 15, circumferentially thereof.

The invention is presented as including all such modifications and changes as come within the scope of the following claims.

What I claim is:

1. A pump comprising a central casing member a pair of heads closing the ends of said member and having hubs projecting toward each other, a pair of cylinder blocks, inserted in the end portions of said central member, and each formed with a plurality of cylinder bores grouped around the shaft, a plurality of pistons working in bores of both cylinder blocks, a shaft journaled in said heads, and a drive element on the shaft, engaged between said hubs and restrained thereby from endwise movement, and operatively engaging all of the pistons.

2. A pump comprising a central annular casing member, a pair of cylinder blocks snugly fitted into the end portions of the central member and each formed with a plurality of cylinder bores, a pair of heads closing the ends of the central casing member and retaining said cylinder blocks in place, pistons operating in the bores of both cylinder blocks, the cylinder blocks having central openings therethrough and said heads having hubs extending into such openings, a shaft journaled in such hubs, a drive element on the shaft operatively engaging all of the pistons, and restrained from axial play by said hubs, an annular plate clamped between each head and the adjacent cylinder block and formed with exhaust ports opening from the cylinders in such block, valves recessed in the heads and controlling said exhaust ports, and means yieldably sealing said valves, each head having an annular passage receiving the exhaust of the cylinders of the adjacent block.

FREDERICK J. HEIDEMAN.